ADVISE-GIVING EXPERT SYSTEMS BASED ON ISLAMIC

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ADVISE-GIVING EXPERT SYSTEMS BASED ON ISLAMIC JURISPRUDENCE FOR TREATING DRUGS AND SUBSTANCE ABUSE

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ABSTRACT

Indonesia is the most populous Muslim country, but yet drugs and substance abuse has not abated. Death penalty to punish drug traffickers does not stopping the statistics on drug-related death to rise. Thus, education about drugs abuse is an essential part of the war against drugs abuse. The daily loss of dozens of lives to drug addiction in Indonesia drew the attention of researchers on how artificial intelligence (AI) can be used as an educational tool to curb drug abuse among youngsters. In this paper, an advice-giving expert system is proposed as an online tool to educate users. The expert system explains and advises the users based on the Islamic Jurisprudence point of view. This research investigates the impact of using the Bayesian Network to the effectiveness of the expert system in giving the right advice based on the user's response or answer to the question asked by the system. Bayesian network is chosen to be used as the inference engine because it organised the graph theory and probability theory. The accuracy of the system is obtained by comparing the output which is the advice given by the system to a human expert in the Islamic Jurisprudence. Based on the 15 cases as a test, the developed expert system using Bayesian Network can diagnose the social problems accurately. Users were advised and explained with the right advice. The daily loss of dozens of lives to drug addiction in Indonesia drew the attention of researchers on how artificial intelligence (AI) can be used as an educational tool to curb drug abuse among youngsters.

Keywords: *Bayesian Network, Drugs, Expert System, Social Problem, Islamic Jurisprudence*

1. INTRODUCTION

Indonesian Narcotics National Bureau in 2014 (INNB) has reported that about 2.1% – 2.25% of Indonesians aged 10 – 59 years old were estimated to be illicit drug users in 2014. Illicit drug use has caused Indonesian people around 200,000 deaths/year and 11.8 million moderate-or-severe disabilities. Drug problems not only affect users and families negatively but also weaken and disrupt the whole society with other crimes such as gangsterism, organised crime, bribery, corruption and even murder. As a sign of sheer grit and determination of every single nation in this world, rich and developing countries in fighting drug abuse, the UN General Assembly decided to observe 26 June as International Day against Drug Abuse and Illicit Trafficking.

Besides strict legislation to control these social problems, education can play a significant role in this endless fight against drugs and substance abuse. Many researchers have rallied to the idea that the educational and training cost could be reduced through the used of online expert systems that could mitigate the learning versus shy or immature conflict.

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Expert System has been used for more than a decade in the field of education. An expert system has been embedded in Computer Aided Instruction and Intelligent Tutoring Systems in giving consultation and advising users in many fields, including health care. This paper proposed an advice-giving expert system based on Islamic jurisprudence. Since the expert system is addressing inputs from users that are often inexact or imprecise, the role of probabilistic support for reasoning is crucial in identifying the type of drugs before the expert system can recommend advice.

The rest of the paper is organised as follows: The background of the research is discussed in the following section and followed by a literature review. Section 4 presents an overview of the methodology of this study, and subsequently, section 5 contains the Bayesian Network as the inference engine process and the implementation of the expert system and section 6 presents the results. Conclusions are presented in the final section 7.

2. BACKGROUND

Drugs prohibition law is critical in controlling the illicit use of a drug. Drug control law prohibits people from possessing drugs that the government has determined to be dangerous. South East Asia nations such as Singapore, Indonesia, Malaysia and Thailand have established a mandatory death penalty for drug trafficking offences. In Indonesia, it is reported that 56 out of 110 death-row prisoners are awaiting execution for drug offences [1]. However, death penalty implemented in these countries does not stop the statistics on drug-related death to rise.

The Amnesty International further points to the Malaysian Inspector General of Police's report, noting that the death penalty does not stop the increasing number of drug traffickers entering the market [2]. Lynch (2009) notice the same trend in Indonesia since it is a crime providing high profits [3]. Lynch suggests that the best way to address narcotic problems is to focus on it from the demand side rather than the sanction side. Thus, the government should also focus on the illicit use of drugs and education about drugs abuse is an essential part of the war against drugs abuse.

A study conducted by Tan et al. (2018) has found that the majority of youngsters were uncertain whether substance use was a problem and dangerous among the youth and this finding was similarly reflected in a study in Ireland [4]. We believe that Indonesian youth is facing the same problem as in Malaysia and Ireland. Therefore, drug education among Indonesian youngsters is essential in fighting drug abuse because young people without knowledge are the natural prey for drug-dealers.

Indonesia is known as the most populous Muslim-majority nation in the world where Islamic education is not just an alternative to secular education but as the way of life. Qur'an and Hadith promote Muslims to read and seek knowledge in shaping a culture of a healthy lifestyle and consistently condemns the illicit use of drugs. The Holy Qur'an states that *"O you who have believed, indeed, intoxicants, gambling, [sacrificing on] stone alters [to other than Allah], and divining arrows are but defilement from the work of Satan, so avoid it that you may be successful.* (QS. Al-Ma'idah, verse 90)."

Islamic law prohibits something intoxicating like alcohol and drugs. Many Islamic scholars could help, give guidance and advice to the younger generation on how to live a healthy and peaceful lifestyle according to the Islamic teachings. However, people and especially youth who are addicted to drugs may feel embarrassed by their illegal and immoral activities and reluctant to get help directly from counsellors or Islamic scholars. The main issue is, people can be too shy to ask other people about his problem.

A recent study by Gratch et al. (2014) has shown that using artificial intelligence as an agent during clinical interviews could be a solution in helping patients with a sensitive, personal and highly stigmatised problem [5]. A computer-mediated consultation can overcome psychological barriers to honesty in consultations. The researchers from the Institute of Creative Technologies used an interviewer program specifically designed for dealing with distressing psychological such as embarrassing and fear situations [6]. Computed based consultation or advice-giving system can be provided to ensure that helps available in a comfortable way.

The need for a computer-mediated consultation for drug addicts has called for a study to develop an online advise-giving expert system as a virtual advisor to improve the knowledge of users regarding substance use. We believe that an online expert system based on Islamic Jurisprudence is vital to overcoming fear or insecure Muslims users as an alternative to modern secular psychology approach because it excludes many religious aspects of life that are widespread and important to Muslims.

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The main difference between the proposed expert system with the informational Websites lies in the advice or explanations available to the user. The use of the expert system can be compared to consulting an anonymous domain expert because the expert system can ask as many questions without fear of the user being embarrassed. Such would be the situation if the use of the program were confidential, which it is not for the test period, but would be in regular use.

An expert system for online instruction is one of the solutions as the internet is relatively cheap to get more information and cybercafé is one of the common ways for poor people to search for their difficulty. Based on data obtained from the police and hospital in Selat Panjang, it has recorded alcohol, methamphetamine and marijuana. A knowledge base is acquired from the scholars of Islamic jurisprudence.

Essentially, many online articles, magazines and health books containing about how to recognise the drug abuses based on physical symptoms. There are many symptoms, both physical and behavioural, that indicate drug use. Each drug has its unique indications, but there are some general signs that a person is using drugs.

The Qur'an is a rule and way of life for Muslims (QS. Al-Baqarah, verse 97), and as a blessing to the whole universe. However, some Muslims have not been able to understand the meaning of Qur'an content, so that consequently they have not been able to make the Qur'an as a point reference. Therefore, this study uses an approach to facilitate understanding of the meaning of the Quran.

Nowadays, many expert systems are being used in Islam science such as decision support system for Hajj Pilgrims, a web-based expert system for Islamic inheritance law for all Muslims and identify the rules of wealth distribution as stated in the Quran through a knowledge acquisition process with an expert in Faraid [7]. The scholars give treatment based on the al-Quran and hadith.

There is a method in the Quran to treat the social illness, i.e., the Al-adabiyijtima'iy method which is used for interpreting of expertise into the knowledge base. Al-adabiyijtima'iy is an interpretation that explains the instruction of the Quran verses which are directly related to the community, as well as an effort to reduce the social issues based on the instructions of Quran and Hadiths by giving the advice which is easily understood [8].

The Al-adabiyijtima'iy method works from the problem of society first. Therefore, this approach has high power solutions. Furthermore, this approach is more expected to solve all aspects of social problems based on creator guidelines [9]. Doctors, psychiatrists, and psychologists are also necessary for this study to support the full knowledge base such as symptoms and treatment.

Building an expert system for the social issues are challenging because it is required to create a knowledge base that is appropriate with the desires of scholars in Islam, doctors, psychiatrists, and psychologists. Different from other cases, the expert system for diagnosing social issues is based on the different content of knowledge base data that consist of symptoms and treatment instruction based on medical science and Islamic jurisprudence. In this study, we selected the Bayesian Network method for the inference engine.

Bayesian Network is considered to be more popular since Bayesian Network-based inference is consistent if it is handled with uncertainty. Bayesian networks can facilitate learning about the causal relationship between the variables [10]. Bayesian Network is easy to be converted into tools for decision support such as to assist the management of natural resources [11]. Hence, the Bayesian Network method is chosen as an inference engine that has been proven to be reliable for the uncertainty problem. Expert systems of social ills are also prone to misdiagnosis. Bayesian Network can provide the percentage of probability of drug abusers. Users may consider the decision result using the probability value for avoiding misinterpretation.

Bayesian Networks show the relationship between different components of the system using the graphics of Bayesian. Therefore, Bayesian Network is comfortable for researchers from different backgrounds to understand the concept of Bayesian Network [12]. The use of Bayesian inference can be readily updated for new knowledge, and Bayesian networks can produce a good prediction accuracy [10, 13]. Bayesian Network is used to determine which type of social illness has the probability to be affecting users. Bayesian Network can calculate the probabilities based on existing symptoms and the system will, later on, be appropriate preventive, medical solutions advice and treatment based on Quran and Hadiths to the type of illness accordingly.

However, self-diagnosis is prone to a misdiagnosis that may endanger the health of users and society if users make a wrong decision. The

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expert system of social problems is slightly different from the medical expert system. The primary purpose of this study is to assist Muslims to find out the right solutions based on social problems they face. Users may not know the indications they are experiencing on what the problem is and how the solution is based on Qur'an and Hadiths. Therefore, this project is not only to develop an expert system but also to educate, give the awareness to the community on how to overcome drug addiction and as online motivation for drug abusers based on Quran, Hadith and advice of experts so that people can get advice and treatment appropriately and as early as possible.

3. RELATED WORK

Turban & Aronson (1998) define an expert system as a system that employs human knowledge captured in a computer to solve problems that ordinarily require human expertise [14]. An expert system imitates the reasoning processes experts use to solve specific problems. In 1990, Wesson and Hink [15], developed an expert system for drug abuse treatment. However, the expert system was developed for a nonspecialist physician when a physician specialist in substance abuse is not available for consultation.

The use of a knowledge-based system in supporting users based on theological knowledge based on religious scripture or belief is not new. For example, Colunelis proposed an expert system for ethical organisational administration based on the pattern of the ethical system of Orthodox Christianity [16]. The ethical process is used to design the flow diagram of the decision-making and judgment-making processes in ethical thought. Mohamed et al. present a novel approach for the decision support system using an Islamic approach [17]. They have proposed a mobile decision support system for Hajj Pilgrims. They planned a dynamic knowledge-based approach to diagnose possible problems and solutions from the expert. The decision support system has been implemented using Case-Based Reasoning (CBR) and Decision Tree. Users can get enquire any questions related to Hajj ritual, especially on Dumm imposition. Nassar et al. [18] researched the influence of social network on publishing on Islam and serving Islam.

According to literature, artificial intelligence has been integrated into the Islamic jurisprudence. Mutawa and Al-Terkait [19] in 2011 published their work on an expert system that supports the process of giving a fatwa or Islamic verdict. Another example of expert systems for the application of law to support Muslims in Islamic jurisprudence is the El Bayane system developed by Nouaouria in 2006 [20]. The quantity of integration of Islam and artificial intelligence technology is insignificant when compared with the application of technology in other fields. Besides, modern methods are also required to obtain accurate results and decisions. Related research is still using traditional inference such as rule base and decision tree method. Currently, there is a modern inference engine that combines graph theory and probability like Bayesian Network.

Meigarani used Bayesian Network to diagnose the diseases [21]. In this study, Bayesian Network is only used to diagnose two possibilities of leukaemia that are positive leukaemia and negative leukaemia. Bayesian Network was used for data analysis and knowledge of experts, especially on uncertainty. This method is used as a solution to a problem that is not certain. Probabilistic method or Bayesian Network can be used to create a model system for transformation between expert knowledge to a computer in difficult medical cases [22-24]. Bayesian networks can be prepared with decision support tools in uncertain cases [25, 26].

Our study is a continuation of the previous study. Previous research has been limited to the data focusing only on drug cases. This study is continued by using a drug abuse case which is rampant in Indonesia [27]. Current our study is more emphasised on the accuracy of determining the probability of each symptom that refers to cases. We provide more detailed symptom on each case. The parameter and conditional probability for antecedent (symptoms) may not be the same with consequent (every disease). Additionally, current research is also being improved on a knowledge base development. The knowledge base is more integrated with various fields such as Islamic jurisprudence, medicine, psychology, law and culture prevailing in Indonesia.

Bayesian Network has been used for a variety of intelligent system applications such as machine learning, signal processing, bioinformatics, medical diagnosis, forecasting, mobile networks, text processing, natural language processing, speech recognition and other intelligent system applications. A Bayesian Network consists of a directed acyclic graph of 'nodes' and 'links' that conceptualise a system. Bayesian Network is

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Probabilistic Graphical Models (PGM) which consists of probabilistic and graph. Probabilistic theory related to the data. The relationships between nodes are described by conditional probability distributions that capture the dependences between variables. Bayes Formula [28]:

$$P(A|B) = \frac{P(A)\,P(B|A)}{P(B)} \quad (1)$$

Where:

A = a particular state, conditional on the evidence provided.
P(A|B) = posterior
P(A) = prior probability of the hypothesis
P(B|A) = likelihood

Joint distribution formula:

$$P(A|B) = P(A)\,P(B|A) \quad (2)$$

4. RESEARCH METHODOLOGY

This research method section describes in more detail the steps that are used for conducting the research. The first step in building an expert system is defining the system model to be used. We use one model to develop an expert system, namely ESDLC (Expert System Development Life Cycle). Expert System Development Life Cycle is a frequently used and fundamental concept in expert systems development. The construct stages of this study are based on the popular evolutionary prototyping. The stages are as follows:

4.1 Literature Review

The literature review describes and validates how this research investigation may assist answer some of the questions or gaps that are related to this study. The literature review is an analysis of existing research which is relevant to the expert system and social illness topic, showing how it relates to this study. These steps include reading and searching information regarding Bayesian Network, social issues on books, journals, and other scientific resources such as web pages and related articles.

4.2 Feasibility study

A feasibility study is a task to objectively and reasonably discover the strengths and weaknesses of an existing system, opportunities, and risks existing in the system, the resources required to build an expert system, and eventually the identify for accomplishment [29]. The described task is where the problems are defined, the objectives are stated, and the resources, methods, experts, costs and the time frame are identified. This step is the necessary analysis which usually carried out in the system development life cycle.

4.3 Knowledge Acquisition

Knowledge acquisition is the step for extracting, organising and structuring knowledge from the human experts to computer. Knowledge acquisition bottleneck is often the major obstacle in building an expert system. In this research, we interviewed the experts associated with social issues such as doctors, psychologists, psychiatrists and Islamic scholars. The pieces of knowledge were acquired from physicians, psychologists, and psychiatrists stationed at the Riau Province Psychiatric Hospital while Islamic jurisprudence related knowledge was acquired from the State Islamic University of Sultan Syarif Kasim Riau. Knowledge elicitation is also conducted, and test cases are prepared. The type of knowledge gathered in this stage is factual knowledge. Islamic scholars can choose one of the two approaches, such as traditional and contemporary in understanding the Quran and Hadith. The contemporary understanding of problem involves understanding issues and facts from the multi-discipline area. The contemporary approach based on the theme of drug abuse is considered appropriate applied to this study since it suitable for a case study. Muslims believe that Islamic scholars are competent in providing rules and opinions regarding social problems. There are several phases in searching the association among social problems based on Quran and Hadith:

1. Collecting verses relating to social problems
2. Preparing the verse based on the purpose and background
3. Understanding the correlation of each verse
4. Organizing a knowledge base properly with the related Hadiths
5. Organization of the whole knowledge base.

4.4 Development

In this step, we have selected the appropriate method to address the problem. Bayesian Network used in this study is for calculating the possibility of people affected by the

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social illness. Subsequently, the data collection and the knowledge acquisition process are conducted into a knowledge base.

Bayesian network is used as an inference engine. All of the steps being taken on the Bayesian network can be seen in Figure 1. This process also discussed the structure of the system menu, user interface, and database; therefore, the system is made following the previous specified design. The treatment and solutions are presented based on the Quran and hadith using Al-adabiyijtima'iy method. An analysis is carried out for the system to be able to work as expected. First, we build a small system containing a few of the features and it is evolved into a better system in a few cycles.

4.5 Testing

The system testing and validation are based on the black box method and User Acceptance Test (UAT). UAT is conducted by using several cases of social ills. An expert assesses the results of an expert system. Based on the analysis and advice, the development steps back to the step of Knowledge Acquisition to correct and expand the factual knowledge from the expert's comments. The purpose of this cyclic development is to improve the quality of the knowledge base and how the inference mechanism.

4.6 Experiment

The particular purpose of the experiment testing is to find out the effectiveness of cooperation of Bayesian Network for an expert system for social ills. The system has been assessed considering the accuracy as the indicator. For this experiment, 10-case sample extraction was made. Each case was then presented to the system to obtain the corresponding diagnosis. This diagnosis was later compared to the one provided by the expert to determine whether or not the system's diagnosis is correct.

5. ANALYSIS AND IMPLEMENTATION

System planning involves the user needs investigations, feasibility studies both technically and technically as well as scheduling expert system development. We complete system planning as a definition of system requirement.

System analysis includes analysis of internal and external conditions. We need to recognise all the problems that arise in the user, recognise the components of the system, objects, and relationships between objects. Here are some processes of the analysis which have been carried out:

5.1 Analysis of Inference

Inference used for the construct of this expert system is the Bayesian Network in the diagnosis process of social illness.

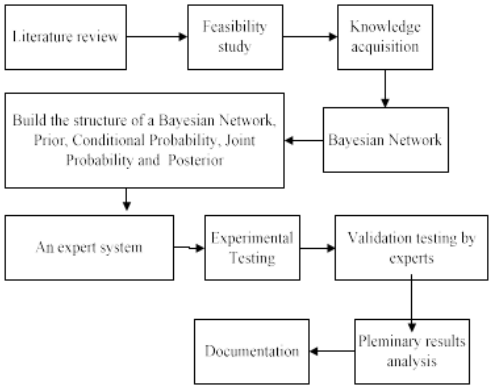

Figure 1: The Steps to Build Expert System

Bayesian Network provides the diagnostic results using the rule based on the learning. The process was performed using the Bayesian Network method and calculating the probability of each symptom from users. Subsequently, the final diagnosis was based on the probabilistic final process. The overview of the implementation of Bayesian Network in an expert system process is shown in Figure. 1.

5.2 Implementation of Bayesian Network

Bayesian network is used to determine the probability of a user in kinds of social illness based on symptoms or characteristics. There are several steps to implement a Bayesian network as shown in Figure. 2.

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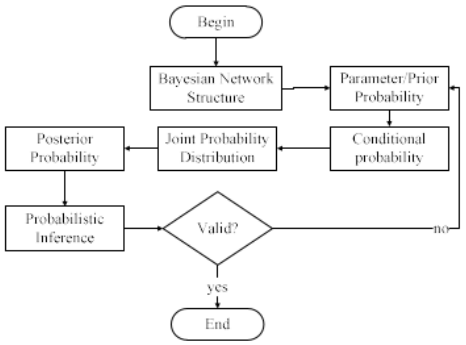

Figure 2: Analysis of Bayesian Network as Inference Engine

5.2.1 Build the structure of the Bayesian Network

The structure of the Bayesian network is formed using graph theory that connects the symptoms or characteristics with the kind of social illness. The following figure is an example of a Bayesian network structure.

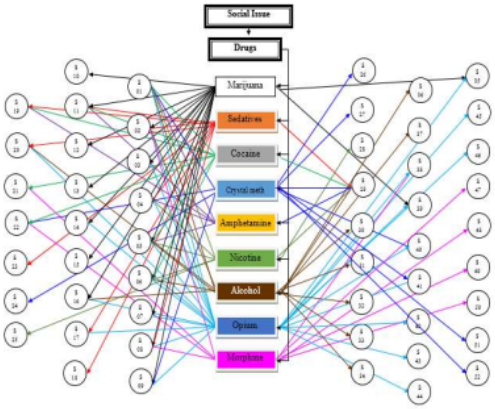

Figure 3: The Structure of Drugs with Certain Symptoms and Kind of Social Issues Based on Expert Knowledge

Based on expert opinion, especially in the medical science and psychology, we got some examples of symptoms of drugs abuse. We have found a challenge in formulating symptoms of drugs abuse into one knowledge base. The formulation of the symptoms particularly may lead to misdiagnosis. Therefore we need the probability value as a consideration for users to use an expert system.

Table 1: Example of Drugs Abuse Symptoms

No	Symptoms
1	Do not sleep for long periods (insomnia)
2	Nausea
3	Myalgia
4	Anxiety
5	Restless
6	Easily offended
7	Fever
8	Sweating
9	Lose appetite
10	Photophobia
11	Depression
12	Confused
13	Often yawning
14	Diarrhoea
15	Weight loss
16	Tremor
17	Gag
18	Sluggish
19	Tired
20	Blood pressure increases
21	Suicide (idea)
22	Paranoia
23	Tremor on the tongue
24	Anxious
25	Black-lined on puffy eyes
26	Headache pain
27	Increased sexual desire
28	Overactive
29	Difficult to concentrate
30	Craving
31	Hallucinations
32	Illusion
33	Seizures in 12-48 hours
34	Skin Redness (face)
35	Red eye
36	A little sluggish
37	Easily startled
38	Shortness of breath
39	Sleepy
40	Flu
41	Dilated pupils
42	High body temperature
43	Bone pain
44	Stomach cramps
45	Respiration increases
46	Convulsions
47	Limp
48	Constipation
49	Difficulty in urination
50	Dry mouth
51	Confusion
52	Always feel thirsty

The formulation of the symptoms particularly may lead to a misdiagnosis. Therefore, we need the probability value as a consideration for

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users to use an expert system. An expert system provides a variety of approaches to educate the people concerning religion and law prevailing in Indonesia. According to the Islamic jurisprudence, drugs are included in the *khamr* and have been strictly forbidden.

5.2.2 Prior Probability

Prior probabilities are the original probabilities of an outcome, which is updated with new information to create conditional, joint and posterior probabilities. In statistical model explains that given data B and parameter A, simple Bayesian analysis beginnings with a prior probability P(A) and likelihood to compute a posterior probability P(A|B) = P(A) P(B|A). Suppose, the prior is given by example if there are 100 users experienced drugs abuse and 80 of them have insomnia, so the prior probability is 0.8. In contrast to the previous study, the current study is more detailed in providing probability. Each symptom has a different likelihood for every disease as shown in Table. 2.

Table 2: Example of Prior Probability

No.	Symptoms	Values
1.	Do not sleep for long periods (insomnia)	0.8
2.	Lose appetite	0.5
3.	Paranoia	0.7
4.	Dilated pupils	0.5
5.	Meth mouth	0.3

5.2.3 Conditional Probability

The conditional probability of an event *B* is the probability of the event will occur given that the knowledge of event *A* has already occurred. This probability is written in formula *(1)* where event *A* does not affect the probability of event *B*, the conditional probability of event *B* which is given event *A* merely is the probability of event *B*, which is *P(B)*.

Table 3: Example of Conditional Probability Table (CPT) for Insomnia With Kind of Drugs Abuse

insomnia	**Cocaine**	
	present	***absent***
present	0.1	0.8
absent	0.9	0.2
insomnia	**Crystal meth**	
	present	***absent***
present	0.1	0.8
absent	0.9	0.2
insomnia	**Amphetamine**	
	present	***absent***
present	0.1	0.8
absent	0.9	0.2
insomnia	**Nicotine**	
	present	***absent***
present	0.1	0.8
absent	0.9	0.2
insomnia	**Alcohol**	
	present	***absent***
present	0.1	0.8
absent	0.9	0.2
insomnia	**Opium**	
	present	***absent***
present	0.3	0.6
absent	0.7	0.4

5.2.4 Joint Probability Distribution

We have used the formula (2), Joint distribution formula, to obtain the Joint Distribution Table (JPT). Based on the formula (2), the calculation of joint probability distribution is multiplying the prior probability Alt conditional probability. It is supposed that the joint probability distribution will be calculated for insomnia. The present insomnia probability is 0.8, while absent probability is 0.2. The Joint Distribution Table (JPT) is shown in Table 5.

Table 4: Joint Distribution Table (JPT)

insomnia	**Crystal meth**	
	present	***absent***
present	0.8 x 0.1 = 0.08	0.2 x 0.8 = 0.16
absent	0.8 x 0.9 = 0.72	0.2 x 0.2 = 0.04

5.2.5 Posterior Probability

In statistical terms, the posterior probability is the probability of event A occurring given that event B has occurred. Based on the Joint Distribution Table (JPT) in *insomnia*, the posterior probability is:

$$Posterior = \frac{0.08}{0.08 + 0.16} = 0.3$$

Table 5: Example of Posterior Probability for Crystal Meth

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No.	Symptoms	Values
1.	Do not sleep for long periods (insomnia)	0.3
2.	Lose appetite	0.4
3.	Paranoia	0.6
4.	Dilated pupils	0.6
5.	Meth mouth	0.4

5.2.6 Probabilistic Inference

The Probabilistic inference is made by tracing the relationship of each symptom and kind of Social illness based on Bayesian Network Structure. Sometimes, BN is combined with Rule-Based Reasoning (IF-THEN) to assist the probabilistic inference.

The probabilistic inference ran according to a Bayesian Network structure. Therefore, the Bayesian network is constructed based on:

1. Construction of Bayesian structure called the qualitative stage, to find out the relation between the variables modelled.
2. Parameters called the quantitative stage, i.e., calculate the probability values.

```
Procedure Probability
Joint_Probability1←Parameters*C
onditional_present1)
Joint_Probability2 ←(1-
Parameters)*absent1
value←Joint_Probability1/(Joint
_Probability1+Joint_Probability
2)
Calculate←i++
Prob←value
       If (calculate <>1)
       Then
       cal2←Prob
       cal3←prob2(calculate)
       prob4←prob*100
       Else
       prob2+←val1
       prob3←val2/(calculate)
       prob4←val3*100
       Endif
End
```

Example:
P (*Crystal Meth* |Symptoms of *Crystal Meth*)

$$= \frac{0.3 + 0.4 + 0.6 + 0.6 + 0.4}{5} = 0.46$$

Thus, it can be concluded that people use *crystal meth* with belief percentage 46 %.

6. RESULTS

This section is the final phases of development to evaluate the effectiveness of the system. The developed system has to produce the desired outcome following its objectives with high accuracy without any systemic error. Tests are conducted using the black box method. The results are presented in term of accuracy and user acceptance test. We compared the outcomes of the expert system with an expert.

User acceptance test is conducted to validate the system output directly to the experts and end-users. 15 cases have been selected and assessed and tested by experts. The following table compares diagnostic results by expert systems and the human expert.

Table 6: Expert System Results

Cases	Diagnosis by Expert System and Probability	Diagnosis by Human Expert
1	Marijuana (63%)	Marijuana
2	Marijuana (46%)	Marijuana
3	Crystal Meth (55.5%)	Crystal Meth
4	Game Addictions (52.5%)	Game Addictions
5	Crystal Meth (30%)	Crystal Meth
6	Alcohol (41%)	Alcohol
7	Crystal Meth (42%)	Crystal Meth
8	Crystal Meth (45%)	Crystal Meth
9	Marijuana (77.5%)	Marijuana
10	Marijuana (48.25%)	Marijuana
11	Paedophilia (57.16%)	Paedophilia
12	Necrophilia (65.42%)	Necrophilia
13	Pornography (64.97%)	Pornography
14	Morphine (41%)	Morphine
15	Paedophilia (40.21%)	Paedophilia

Some knowledge base data have similar diagnoses with a human expert. The accuracy of a diagnosis by the expert system is better when a user provides (selects) more symptoms. Thus, an expert system results are as expected. Furthermore, the user acceptance test results were also obtained based on the questionnaire previously distributed to 30 respondents. Some aspects became the assessment that can be seen in Figure 3. It could be concluded that the expert system can be used easily by the users and it is useful.

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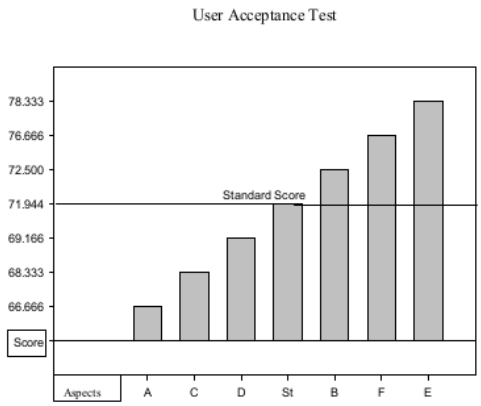

Figure 3: User Acceptance Test Result

Where:

A= Graphical user interface
B= Easiness of the use application
C= Completeness of expert system features
D= Easiness in obtaining information regarding social problems
E= Usability
F= Overall expert system assessment
St= Standard Score

Based on the results in some tests it can be stated that a multi-science expert system that uses Bayesian Network can be used as an educational medium for people who want to know the solutions, characteristics, cause, and effect of social problems such as drug abuse.

In the previous study, we concentrate on drug abuse diagnosis features. A drugs probability values are generally not detailed in a single type of drugs. A significant finding of the current research is that we have successfully integrated many sciences into one knowledge base format. This expert system provided a more detailed of prior probability and conditional probability for every characteristic. The current expert system is more accurate and provides a more appropriate probability value for a user's consideration.

7. CONCLUSION AND FUTURE WORK

We have successfully continued preceding research by enhancing the probability, knowledge base and involved medical experts and Islamic scholars. An expert system has been developed and equipped with a Bayesian Network as an inference engine. Bayesian network is appropriately used as an inference engine because it organises both graph theory and probability theory. Bayesian graph theory facilitates us to communicate knowledge base with experts in knowledge acquisition phases while the probability theory helps users assess the symptoms and correct the rules. Based on the experimental results, it can be concluded that Bayesian Network shows its capability to classify social issues according to what users experienced and the solution following medical science, Quran, and Hadiths.

Developing an expert system for the social issues is challenging because it is necessary to construct a knowledge base that is suitable with the desires of psychology experts, Islamic scholars and medical experts. Therefore, the project is not just to develop an expert system but also to educate, give the awareness to the community about drug and substance abuse and how to overcome it and as online motivation for drug abusers based on Quran, Hadith and advice of psychology and medical experts. A user will get advice and treatment appropriately and as early as possible.

However, this expert system still needs improvement to attain a full-size expert system in the social issues. This study only focuses on social problems meanly drug abuse. There are still some social problems that need to be included as a significant knowledge base. The effectiveness of the expert system is derived from the completeness of the knowledge base provided. Determining of prior probability and conditional probability is very important when applying Bayesian Network as the inference engine.

The current study still based on expert estimates with repeated validation. The effectiveness in determining the opportunity value is critical to be considered by the researcher. The growth of database technology has been beneficial in building the big knowledge base. Nowadays, big data may help in building an extensive, useful and right knowledge base expert system.

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